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Title : "Method of surface treatment"

The present invention relates to a method for surface treatment of friction members like brake discs, drums, clutch parts and more particularly to treatment of PMMC based members and further to thereby provided friction members.

Conventional brake discs are presently made of ferrous alloys/cast iron having satisfactory performance and maintaining operative even at substantially elevated temperatures up to above 700°C.

However, the present tendency in the automotive industry to reduce the total weight of vehicles challenges new lighter materials to penetrate also this particular segment of vehicle construction. Furthermore, improved corrosion resistance, as well as wear resistance increasing the lifetime of the friction members up to the expected life period of the vehicles, is also a task when looking for replacement of the present ferrous materials.

Consequently, several patent applications have been filed world-wide recently disclosing use of PMMC (Particle Metal Matrix Composite, e.g. Al-alloy matrix reinforced by ceramic particles) based components applied for different actual applications in vehicles. Shortcomings in common for all these applications based on PMMC base material are the softening phenomena at elevated temperatures, something which results in scoring and even plastic deformation of the members' surface, thus considerably limiting the maximum allowed operating temperatures of the members. Therefore, as a remedy, it is instrumental to provide the basis PMMC-made friction members either with a special composite/ceramic coating layer (thermal spraying of ceramics), or with a transfer surface layer.

The provision of an alternative transfer layer requires the layer to be both stable (adherent to the substrate and reliable) and homogeneous. Furthermore, fast formation of the layer having a sufficient thickness is also requested both from a manufacturing, cost and performance point of view.

One feasible way to cope with the task of increasing the maximum operating temperature is simply to increase the volume percentage of reinforcing particles. Unfortunately, two major disadvantages connected to this "solution", namely increased costs of the PMMC base material and difficulties related to production/casting and especially cutting/machining of the surface, eliminate this as a possibility for a cost efficient manufacturing method.

It is therefore an object of the present invention to provide a novel, fast and cost efficient method of manufacturing friction members avoiding the above mentioned drawbacks and difficulties connected to the hitherto known methods and products.

Another object of the present invention is to provide a fast developing and homogeneous transfer layer exhibiting improved friction properties.

Still another object of the present invention is to provide better protection for the base matrix material against elevated (higher) temperatures and shear loads.

These and other objects and features of the present invention are met by provision of a novel manufacturing method of friction members as apparent from claim 1 and the resulting friction member and its preferred embodiment(s) in claims 5-

The invention will now be described in detail in the following by way of examples of preferred embodiments of the manufacturing method and the resulting members referring to Figures 1-2, where

Fig. 1 shows in a perspective view a typical disc brake system,

Fig. 2 illustrates schematically in principle the novel surface topography of the friction member treated in accordance with the present invention, and

Referring to Figs. 1 and 2, Fig. 1 shows a disc brake system where the brake disc 1 is the rotating part which together with the friction linings 14 held in place by the caliper 13 creates the friction.

The novel surface treatment according to the invention is applied to the friction surfaces 12 of the disc.

Fig. 2 illustrates schematically a detailed view of the surface of the member (disc) 12 treated in accordance with the present invention.

Contrary to the present practice and trend to add a special surface layer, e.g. in the form of a composite or sprayed ceramic layer, the gist of the present novel treatment method lies in a selective partial removal of the base matrix material from the active to be frictional surface(s) of the member.

The Figure shows in a cross sectional view the (top) surface 2 of the member 1, where the original top layer depicted as 23 has been removed according to the present invention most advantageously by means of chemical etching. This treatment results in a novel surface topography exhibiting a surface with reinforcing (ceramic) particles 22 protruding from the matrix 21, later during the initial break-in activating of the brake system becoming an integrated part of the transfer layer created through initial wear and material transfer from the lining (pad) material. The resulting increased thickness of the transfer layer will provide better protection of the matrix alloy from temperature and shear forces.

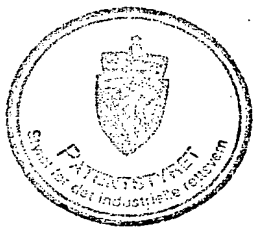
Tests conducted on samples of PMMC discs provided (surface treated) in accordance with the method confirm formation of a fast developing adherent and homogenous transfer layer exhibiting substantially improved performance characteristics of the treated member.

Example

Samples of brake discs made of two different AlSiMg matrix alloys reinforced by SiC particles in an amount of 10 to 30 vol% having a size in a range from 5-30 μ have been subjected to chemical etching applying 10% solution of NaOH for 20 minutes.

Comparison to the reference samples based on the measurement of surface roughness, friction and performance at elevated temperatures shows improved characteristics on all measured parameters.

The present invention is not limited to the above described examples of the preferred mode of the surface treatment. Thus also other (similar) methods of surface treatment, e.g. electrochemical pickling or chemical etching by means of an appropriate acid, could be applied without departing from the spirit and scope of the present invention.



Claims

1. Method of surface treatment of friction members, particularly brake discs/drums or clutch plates in vehicles comprising steps of
   - providing friction members made of PMMC material by any conventional method known per se,
   - in situ formation of a transfer layer on the active side(s) surface of the member by removing to a predetermined extent the top layer of the matrix material hereby exposing the surface of the embedded reinforcing particles to a degree providing a transfer layer with increased thickness and stability.

2. Method according to claim 1,
   characterized in that
   the in situ formation of the transfer layer is strongly improved by means of previous chemical etching of the PMMC material.

3. Method according to claim 2,
   characterized in that
   sodium hydroxide (NaOH) in concentrations from 5 to 30% is applied as the etching medium.

4. Method according to claim 2,
   characterized in that
   acid reagent is applied as the etching medium.

5. Method according to claim 1,
   characterized in that
   the in situ formation of the transfer layer is done by electrochemical pickling of the PMMC material.

6. Friction member, particularly a brake disc/rotor in an automotive vehicle,
c h a r a c t e r i z e d i n t h a t
the member comprising a PMMC body of Al-alloy reinforced by ceramic particles is provided with a surface topography characterized by surface protruding reinforcing particles hereby increasing the total (available) frictional surface of the member and exhibiting higher concentration of the particles compared to the base material.

7. Member according to claim 6,
c h a r a c t e r i z e d i n t h a t
the Al-alloy is an AlSi alloy reinforced by SiC particles.

Abstract

Method of surface treatment of friction PMMC members like brake discs is based on in situ formation of a transfer layer by controlled partial removal of the matrix material from the member's surface.

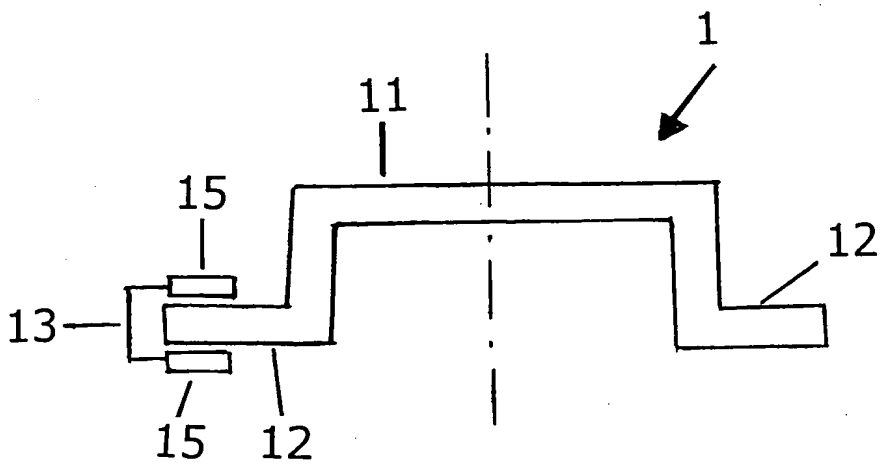


Fig. 1

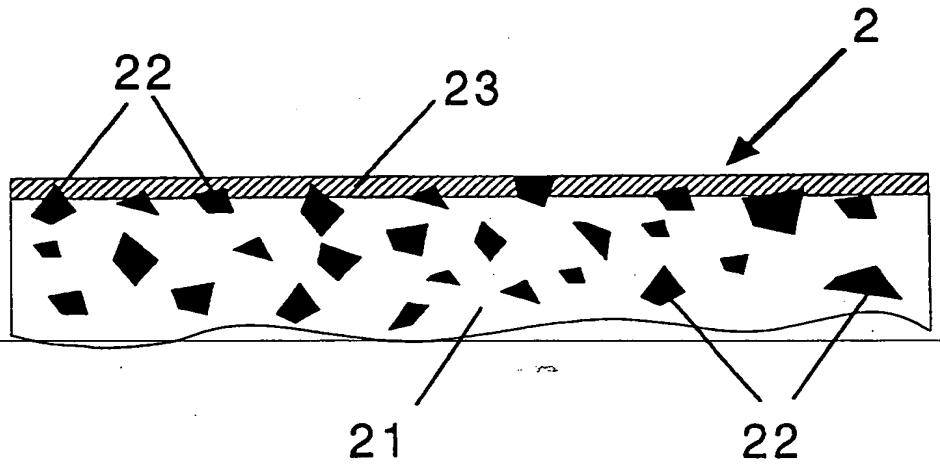


Fig. 2